

## **drainage systems**

Ditches, underground pipes, and other devices and techniques used to remove excess water from land constitute drainage systems. Such systems are built to reclaim land for farming, as adjuncts in IRRIGATION projects, in mining, in road and building construction, and for insect control.

Wetlands—places where the soil is almost constantly saturated with water—are created either by surface water collecting faster than it can be absorbed into the ground, or by a water table that is almost as high as the land surface (see SWAMP, MARSH, AND BOG). The construction of systems to drain wetlands is an ancient agricultural technique, practiced on a huge scale by the Aztecs in pre-Columbian times and by many other agricultural civilizations. The Dutch literally built up much of their country from salt- and fresh-water marshes, beginning about AD 1000 and continuing to this day (see LAND RECLAMATION). Drainage of the Italian PONTINE MARSHES, begun by the ancient Romans, was completed under Mussolini; a network of canals was built to drain about 70,000 ha (175,000 acres) of swamp, converting it to farmland. In recent years, drainage of wetlands has been practiced on a large scale in the United States. An estimated 50% of all wetlands in the United States have been drained for agriculture or development.

### **Drainage Techniques**

Most large-scale drainage systems consist of surface drains—basically, lined ditches, both covered; and small-diameter tile pipe, laid below the soil surface. Many crops will not grow well if the soil within 1.2 m (4 ft) of the surface is permanently saturated with water, and tile pipe serves to remove water in that soil level. Both surface and below-ground drains are designed to move water away from the drained area via gravity. Where the land is flat, it is graded to create a slight slope. In irrigated fields with clay or other water-retaining types of soil, water salts may build up in the ground and can be leached out only with the application of more water. Thus, irrigated areas like California's Imperial Valley must build extensive drainage systems to maintain soil fertility.

### **Environmental Considerations**

Less than 40 million ha (100 million acres) of wetlands remain in the United States today. Increasing knowledge of the vital ecological role they play has slowed U.S. wetlands conversion. Until 1977 the U.S. Department of Agriculture (USDA) subsidized drainage projects. Today the USDA will no longer share the cost of draining permanent wetlands and in 1979 it began the Water Bank program, which pays farmers to preserve wetlands for wildlife.

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Bibliography: Farr, E., and Henderson, W.C., *Land Drainage* (1986); Luthin, James N., *Drainage Engineering* (1966; repr., 1978); Schwab, Glenn O., and Frevert, R.K., *Elementary Soil and Water Engineering*, 3d ed. (1985).

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